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Management of Stem Rot of Groundnut (*Arachis hypogea* L.) using Organic Amendments and *Trichoderma viride*

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A B S T R A C T

Groundnut is a major legume and important oil seed crop belongs to family Fabaceae. A large number of diseases attack groundnut plant in India, of these stem rot caused by *Sclerotium rolfsii* is the most common disease. The present study was conducted in experimental field of SHUATS for management of stem rot disease of groundnut (*Sclerotium rolfsii*) which is most important destructive disease of groundnut in India. Therefore present studies were undertaken to test *Trichoderma viride*, Neem cake, vermicompost and the combinations along with the treated check (Vitavax). In *in vitro* conditions *Trichoderma viride* + Vermicompost + Neem cake significantly reduce the disease incidence of Stem rot (15.53%) as compared to treated check with (12.27%) and control (54.4%) and also maximum shoot length (54.60), root length (29.47), dry weight of plants (19.47), dry weight of roots (1.53), pod yield of plants (12.16), kernel yield of plants (7.98) was observed in *Trichoderma viride* + Neem cake + Vermicompost. In *in vivo* conditions highest growth inhibition was observed in treated check (89.29%) followed by *Trichoderma viride* (60.15%) and Neem cake (28.66%).

Introduction

Groundnut (*Arachis hypogea* L.*)* is a major legume and oilseed crop in India and in many Asian countries. In world groundnut is grown in an area of about 21.7m.ha with a production of 38.6 tones (FAOSTAT 2011). The productivity of groundnut crop in India is about (1194kg/ha) and production of 7180.5 thousand tonnes in an area of 6.8m.ha In Uttar Pradesh it is grown in an area of 0.85m.ha with a production of 65000 tones and productivity is 812kg/ha. (Directorate of Economics and Statistics and Crops Division, DAC & FW, India 2015-16), compared to world average (1328kg/ha) (FAO 2002).

Groundnut is called as the ‘‘King of oilseeds’’. It is one of the most important food and cash crops of our country. While being a valuable source of all the nutrients, it is a low priced commodity. Groundnut is also called as

‘‘wonder nut’’ and ‘‘poor men’s cashew nut. Groundnut seeds are valued for oil (40-48%) and protein (22-26%) also contain carbohydrate (26%) fat (3%) and high calcium, thiamine and niacin contents, which make a substantial contribution of protein for human and animal nutrition (Maiti and Sen, 1984).Several factors are responsible for low productivity among them diseases like leaf spot, collar rot, stem rot, bud necrosis etc. are very important. Several fungal species have been reported to be associated with groundnut seed. Among the different pathogens attacking the crop, *Aspergillus niger*, *Aspergillus flavus*, *Rhizoctonia bataticola* and *Sclerotium rolfsii* are the most important fungi causing seed and seedling rots and stem rot diseases. Among the soil-borne fungal diseases, stem rot caused by *Sclerotium rolfsii* is a potential threat to successful groundnut cultivation.

The disease is distributed through out the world and prevalent particularly in warm dry climates. It was first reported by Clintock(1917) in Virginia. The loss of yield caused by the pathogen is 25%, but sometimes it reaches to 80-90% (Grichar and Bosweel, 1987). Adiver (2003) reported the yield loss of 15-70% in groundnut is due to leaf spot, rust and stem rot singly or in combination. Stem rot caused by *Sclerotium rolfsii* survived for years by producing sclerotial bodies and causing the disease on various hosts Weber and Garett (1956). *S. rolfsii*is a polyphagous soil borne facultative parasite and induces root rot over 500 species of plants (Punja, 1985). Though the fungus is seed and soil borne, soil borne inoculums is more important in causing infection and disease development.

Sclerotia may be spherical or irregular in shape and at maturity resemble the mustard seed (Barnett and Hunter, 1972). Sclerotial size was reported to be varied from 0.1 mm to 3.0 mm (Ansari and Agnihotri, 2000; Anahosur, 2001). Biological control has attained importance in modern agriculture to minimize the residual effects due to continuous and indiscriminate use of toxic chemicals for disease control.

Though chemical pesticides have played an important role in increasing groundnut production and management of root rot, their indiscriminate use for the control of pests has led to several environmental problems such as development of resistance in pests to pesticides, pesticide residues and the destruction of beneficial parasites and predators of pests. Thus other alternative disease management options were considered among which biological control appears promising. Majority of the existing bio-control agents for management of soil-borne diseases, were isolated from the rhizosphere. *Trichoderma* have been used as effective bio-control agents against soil-borne, foliar and postharvest phytopathogenic fungal pathogens in several plant crops (Kubicek*et al.*, 2001; Sharma *et al.*, 2001) including groundnut (Podile and Kishore, 2002). These fungi may also promote plant growth (Inbar*et al.*, 1994) and have the ability to colonize root surfaces and the cortex (Kleifeld and Chet, 1992).

*Trichoderma spp.*are widely used in agriculture as bio-pesticides, bio-protectants, bio-stimulants, and bio-fertilizers on a wide variety of plants (Harman and Kubicek, 1998). Addition of organic amendments to soil exerted favorable effect on disease reduction due to its suppressive nature (Adiver, 2003).

The organic amendments not only increase the activity of bio-control agents but also acts as source of nutrients to crop plant.

Materials and Methods

For isolating and culturing of pathogen (*Sclerotium rolfsii*) Potato Dextrose Agar (PDA) medium was used.

Isolation and identification of pathogen

Small pieces of tissues about 3mm from infected collar region with some healthy tissue where cut with sterile scalpel. Then the pieces surface sterilized with 1 % sodium hypochlorite solution for 30 sec. The tissue pieces were subsequently washed in three changes of sterile distilled water to eliminate excess sodium hypochlorite and then pieces were transferred to PDA plated petri dishes plates were incubated at 28 ± 2^0 C and were observed periodically for growth of the fungus. The culture was purified by single hyphal tip method. The pathogen was identified as *Sclerotium rolfsii* based on its mycelia and sclerotial characters (Barnett and Hunter, 1972).

Dual culture technique

20 ml of sterilized PDA was plated in 9 cm petri plates and allowed to solidify. Mycelial discs of 5mm diameter of the antagonists as well as the test pathogen were cut with sterile cork borer from the periphery of an actively growing three day old culture and then placed on opposite sides of petri plate. The distance between inoculums blocks was 7cm.

The inoculated petri plates were incubated at 28±2^0 C for three days. The petri plates isolated with pathogen alone served as control. Three replications were maintained per treatment. The percent reduction in radial growth and sclerotial population of the test pathogen was calculated by using the following formula.

$$I = \frac{R_1 - R_2}{R_1} \times 100$$

Where,

R1, Radial growth of *Sclerotium* colony in control plate;

R2, Radial growth of *Sclerotium* colony in dual culture plate

Poisoned food technique

Five mm diameter of culture disc of *Sclerotium rolfsii* was kept at the center of each petri plate containing the fungicides of required concentration dissolved in PDA . Three replications were maintained. The plates were incubated at 27℃ for ten days and colony diameter was recorded. Per cent inhibition of mycelial growth was calculated by using the formula given by Vincent (1947).

$$I = \frac{C - T}{C} \times 100$$

Where

C = Mycelial growth in control.

T= Mycelial growth in treatment.

In vivo analysis

Disease incidence percentage (%) recorded.

Observation on disease incidence recorded for a period of 30, 60 and 90 days after transplanting (Wheeler, 1969).

$$\text{Disease Incidence}(\%) = \frac{\text{Total number of infected plants}}{\text{Total number of plants}} \times 100$$

Results and Discussion

In vitro evaluation is done by dual culture and poisoned food technique and the data on the mycelial growth influenced by bio-agent are presented in below table. Minimum average radial growth of *Trichoderma viride* against *Sclerotium rolfsii* was observed in T_1*Trichoderma viride* (34.03 mm) as compared to T_0 control (85.40 mm).

***In vitro* effect of Neem cake and Vitavax on mycelial growth (mm) of *Sclerotium rolfsii*.**

The least radial growth of *Sclerotium rolfsii* was observed in T_7Vitavax (9.11 mm) followed by T_3Neem cake (60.71 mm) as compared to control T_0 Control (85.10 mm). The similar findings is reported by Saralamma and Vittal Reddy (2003)where they notice combined application of bio agent, fungicide and neem cake effectively suppressed *Sclerotium rolfsii*, the incitant of stem rot in groundnut. Varadarajan karthikeyan, Ambalavanan (2006) also reported that *Trichoderma viride* is most effective in suppressing sclerotial formation. Among the organic amendments tested mahua cake with *Trichoderma viride* each @ 5g/kg of soil resulted in 3.75% stem rot incidence as against 39.98% in control. Palaiah*et al.*,(2007) also reported that using more than one type of bio-agent for the management of *Sclerotium rolfsii* in addition to using both chemical and bio agent tools for its better management. Similar findings were reported by Saralamma and Vittal Reddy (2003) also that combined application of pathogen + bio-agent + fungicide + neem cake gave higher yield of 863 kg/ha over control (224 kg/ha) respectively.

Table.1 Details of the Treatments

TREATMENTS	CONCENTRATION
T_0 _Control	_
T_1- *Trichodema viride*	1.5 g/kg
T_2- vermicompost	10tonnes/ha
T_3-Neem cake	500kg/ha
T_4- *Trichodema viride*+vermicompost	1.5 g/kg + 10 tonnes/ha
T_5-*Trichodema viride*+Neem cake	1.5 g/kg + 500 kg/ha
T_6-*Trichodemaviride*+Neem cake+vermicompost	1.5 g/kg + 500 kg/ha + 10tonnes/ha
T7-Vitavax	2g/kg

Table.2 Antagonistic effect of *Trichoderma viride* on mycelial growth (mm) of *Sclerotium rolfsii*.

S.NO	TREATMENTS	Radial growth (mm) of *Sclerotium rolfsii*				
		24hrs	48hrs	72hrs	96hrs	120hrs
T_1	*Trichoderma viride*	11.9	25.2	28.6	31.8	34.03
T_0	Control	34.8	51.1	71.9	77.4	85.4
F-test		S	S	S	S	S
SE.d		0.15	0.26	0.38	0.31	0.49
CD (5%)		0.65	1.12	1.65	1.36	2.14

Table.3 *In vitro* effect of Neem cake and Vitavax on mycelial growth (mm) of *Sclerotium rolfsii*.

S.NO	TREATMENTS	Radial growth (mm) of *Sclerotium rolfsii*				
		24hrs	48hrs	72hrs	96hrs	120hrs
T_0	Control	34.96	50.9	72.07	77.05	85.10
T_3	Neem cake	20.16	42.10	50.06	58.11	60.71
T_7	Vitavax	1.73	4.76	6.99	7.96	9.11
F-test		S	S	S	S	S
SE.d		0.24	0.29	0.32	0.36	0.37
CD (5%)		0.67	0.82	0.89	1.02	1.03

Table.4 Effect of organic amendments and *Trichoderma viride* on percentage of disease incidence (%) of *Sclerotium rolfsii* at different DAS

TREATMENTS	60 Days	75 Days	90 Days
T_0	31.10	44.40	54.4
T_1	14.47	21.10	28.87
T_2	24.40	36.60	42.27
T_3	21.10	28.90	34.47
T_4	10.00	16.60	21.10
T_5	7.78	14.40	18.87
T_6	5.56	11.10	15.53
T_7	4.44	10.00	12.27
F-test	S	S	S
S.Ed.	0.75	0.91	1.09
C.D. (=0.05)	1.61	1.95	2.35

Fig.1 Sclerotial bodies on pathogen

Fig.2 Microscopic view of pathogen

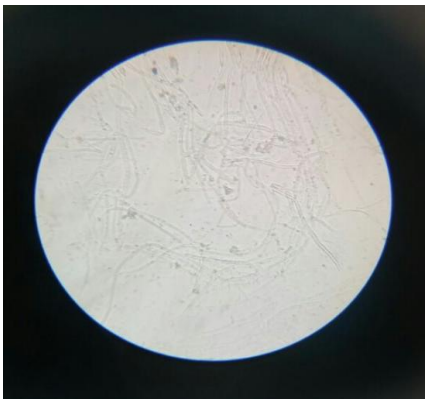


Fig.3 Antagonistic effect of *Trichoderma viride* against growth of *Sclerotium rolfsii* (Dual Culture Technique)

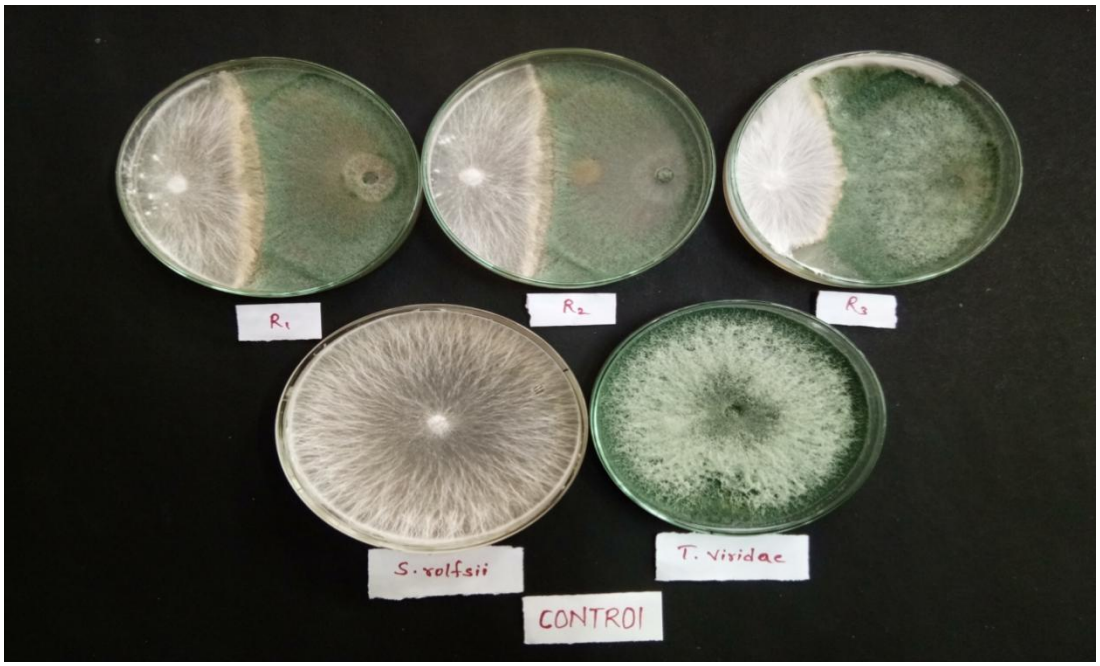
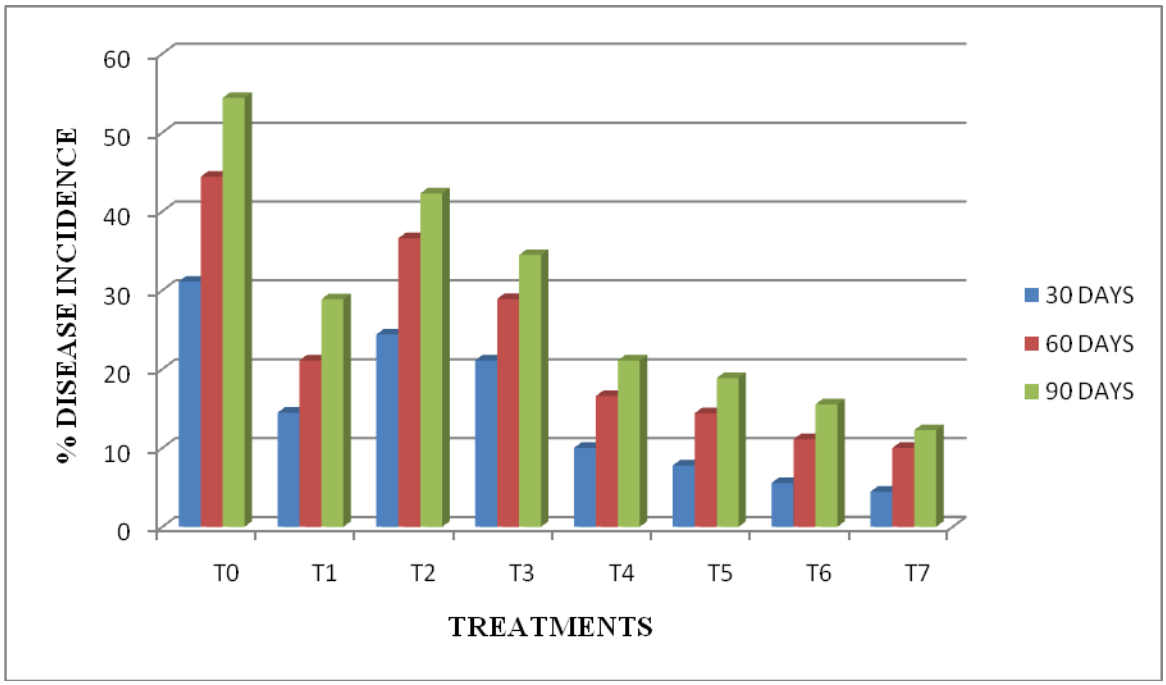


Fig.4 Poison food technique treated with vitavax Fig 4.3 Poison food technique with neem cake

Fig.5 Graphical representation of field efficacy of treatments on the incidence of *Sclerotium rolfsii* (%) of groundnut at different DAS



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